Investigating the climate predictability in the Southern Ocean using global and regional coupled models

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THE PARAMOUR PROJECT (2019-2022)

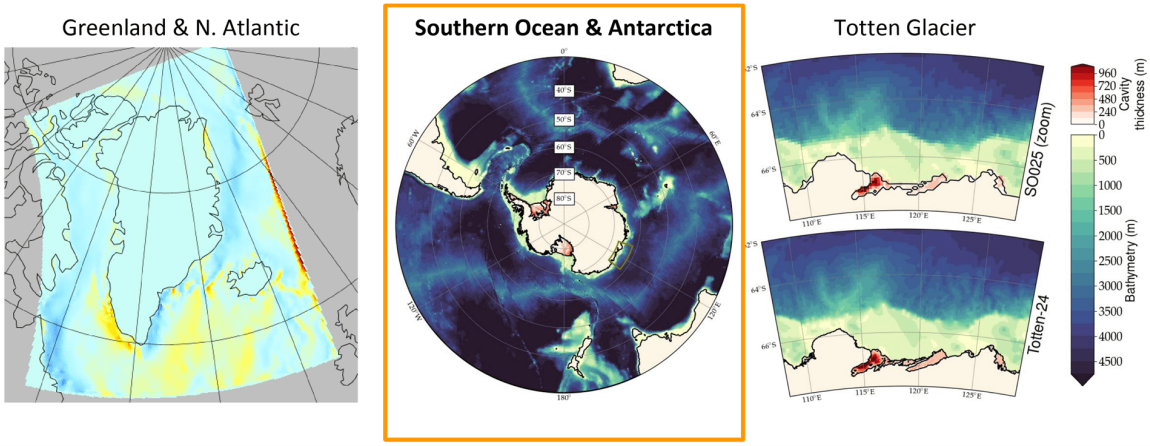
PARAMOUR

Decadal Predictability and vAriability of polar climate: the Role of AtMosphere–Ocean–cryosphere mUltiscale inteRactions:

Main goals:

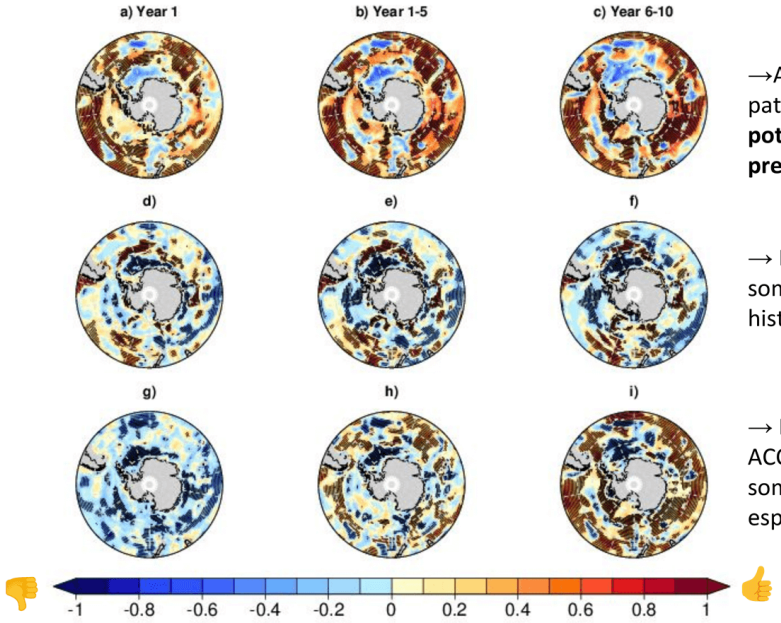
1. understnad fundamental drivers of climate variability
2. assess decadal predictability in polar regions

Coupled atmosphere–ocean–sea ice–ice sheet regional climate models (RCMs) driven by global climate models (GCMs) over 3 domains



PREDICTABILITY IN THE EC-EARTH CMIP6 DCPP

1960–2016 Anomaly Correlation Coefficients (ACC) in the 300 m ocean temperature wrt EN4



→ACC in CMIP6 DCPP:
patchy **significant skill** in some regions
potential impact on ice-shelf predictability?

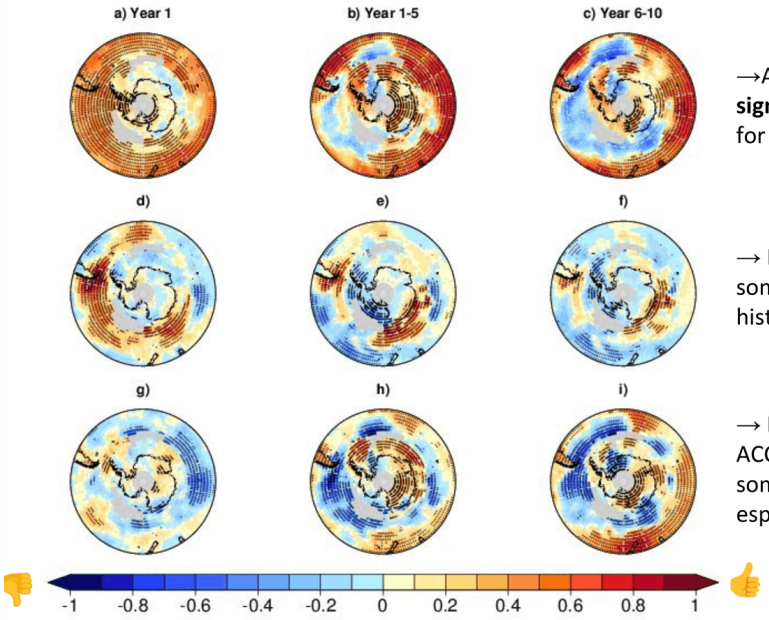
→ DCPP–historical ACC difference:
some **added-value** of DCPP over historical runs

→ DCPP–simple persistence forecast ACC difference:
some **skill beyond persistence**, especially for long forecast times

Dots indicate significant correlation (a-c) and significant difference of correlations (d-i) at the 95% level.
Missing values in observations are masked in grey.

PREDICTABILITY IN THE EC-EARTH CMIP6 DCPP

1961–2018 Anomaly Correlation Coefficients (ACC) in the surface temperature (SST & SAT) wrt GHCN-ERSST-GISS



→ACC in CMIP6 DCPP:
significant skill in some regions, also for long forecast times

→ DCPP–historical ACC difference:
some **added-value** of DCPP over historical runs

→ DCPP–simple persistence forecast ACC difference:
some **skill beyond persistence**, especially for long forecast times

Dots indicate significant correlation (a-c) and significant difference of correlations (d-i) at the 95% level.
Missing values in observations are masked in grey.

PRELIMINARY CONCLUSIONS

- **Skill** in EC-Earth CMIP6 DCPP in predicting **surface and ocean subsurface temperature** in some regions, for short and long forecast times
  → Potential impact on the **predictability of sea ice and ice shelves**
- **Added-value** in certain regions compared to uninitialised runs and persistence
  → **impact of initialisation and specific physical processes/feedbacks**
- Further analyses are required, especially using **coupled RCM simulations**

ABSTRACT

PARAMOUR (Decadal Predictability and vAriability of polar climate: the Role of AtMosphere-Ocean-cryosphere mUltiscale inteRactions) is a new project funded in the framework of the Belgian program EOS - The excellence of Science. It aims at revealing fundamental drivers of climate variability and assessing the predictability in high-latitudes by using coupled regional climate models in both hemispheres. Here, we present ongoing efforts by the Earth and Life Institute in Louvain-la-Neuve (ELI, Belgium) and the Barcelona Supercomputing Center (BSC, Spain). ELI and BSC efforts center around two main objectives. The first one seeks improving our understanding of key processes controlling variability in the ice–ocean–atmosphere system at decadal timescales, first focusing on interactions between these climate components at a regional scale, and later on links at larger spatial scales. The second objective aims to determine how those interactions can provide some predictability at decadal timescales in the full ice–ocean–atmosphere system or in any particular components alone. Achieving these two objectives will require the development of coupled regional models including atmosphere, ocean, sea ice, and ice sheet models, and all driven by boundary conditions generated with a global coupled climate models. Three model configurations are proposed in PARAMOUR, covering 1/ Greenland, the Arctic, and the North Atlantic, 2/ Antarctica, and the Southern Ocean, and 3/ The Totten Glacier region. Here we focus on the latter two configurations, over Antarctica and the Southern Ocean. Retrospective (1980-2015) and prospective (2015-2045) climate simulations at high resolution are planned to be conducted to evaluate the respective role the initial conditions, specific physical processes, teleconnections, and couplings in recent trends, and to investigate potential fluctuations of key climate indicators within the next few decades. A specific aspect will also be to determine the added-value of regional compared to global modeling.